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TESTING AS A PART OF MILITARY CLASSIFICATION

BY THE STAFF, PERSONNEL RESEARCH SECTION, CLASSIFICATION AND REPLACEMENT BRANCH, THE ADJUTANT GENERAL'S OFFICE

GENERAL

THE construction of psychological tests for use in the classification and assignment of Army personnel is a function of the Personnal Research Section of the Classification and Replacement Branch, The Adjutant General's Office, War Department. The Classification and Replacement Branch is responsible for developing procedures for classifying and assigning all men in the Army with the exception of those in the flight crews of the Air Forces; it develops the policies and prepares the regulations which are used by classification officers in the field. An organizational and functional chart (Fig. 1) of the Personnel Research Section accompanies this article.

The two main objectives of classification are to conserve manpower and expedite training; it is a process through which pertinent data concerning each enlisted man are validly obtained and accurately recorded for use as a basis in making the assignment in which he will be of greatest value to the Service. Tests are employed at every stage of the complex classification process which continues throughout each man's military career. The personnel consultant and the classification and assignment officers in the induction stations, the reception centers and the replacement training centers of the Arms and Services, and in the tactical units and posts administer tests as an integral part of classification and assignment. The principal divisions and stages of the personnel classification system are indicated in Fig. 2.

Army needs dictate the types of tests in use. The number of tests of all types used in the Army has steadily increased since the initiation of the present classification system. Current tests and procedures

are of many varieties: written tests, oral tests, performance tests and standardized interviews. In general, tests are designed to be objective, specific and suitable for group administration. Practically all may be scored either by machine or by hand-applied stencils, and, with few exceptions, raw scores can be converted to standard scores and Army grades, which have a common meaning and interpretation throughout the Service. It is important to understand that tests are only part of the classification or selection process and that they are always used in conjunction with ratings made by trained interviewers, commanding officers under whom the man is serving, or, in the case of officer candidates, special boards of selection.

Procedure in Test Development

After the need for a new test has been recognized and the project has been approved for development, the first step in construction is the determination of its type and scope, based on an analysis of the activities or job for which the test will select men. Then test items are written; in this process, technical experts and the technical literature are consulted, and available tests of the same nature are reviewed. After the items have been reviewed, the test is issued in a preliminary form and tried out on a sample Army population similar to that for which it is ultimately intended. Data obtained in this manner are then analyzed to obtain measures of the reliability and validity of the trial test. The difficulty of items is determined, and each is analyzed to determine the degree to which the right answer discriminates between individuals who score highest and lowest on the whole test. The reliability of the test as a whole is computed, generally by the Kuder-Richardson method. Studies of validity are made by correlating the score on the whole test with, and by analyzing the relation of each test item to, an outside criterion such as a rating of job performance or final grades in special Army training. The results of these statistical analyses determine what further work is necessary to develop the final test form and which items should be included.

Once the final test has been reproduced, it is administered to a new sample population for the purpose of standardization. The standardization of Army tests is essentially a process of constructing a framework for the interpretation of test performance which will apply to men at all levels. For tests of Army-wide usefulness, the standard group is selected to represent all levels of performance in the proportion in which they are found in the Service. When a test is constructed to measure a skill specific to some section of the Army, the standard group is selected from that section. On this basis, raw scores are converted to standard scores with a mean of 100 and a standard deviation of 20. Test scores may also be expressed in terms of five grade levels: I—standard scores of 130 and above; II—standard scores from 110 to 129; III—standard scores from 90 to 109; IV—standard scores from 70 to 89; V—standard scores of 59 and below.

In addition to standard scores, some qualifying or critical score may also be necessary, but such a score is often subject to change, depending upon Army needs. For example, qualifying scores may be raised or lowered according to the number of men available for the training involved. After a test is in operation, further checks are made to determine validity under actual operating conditions, to indicate need for revision as conditions change, to study trends in selected populations, and to determine the possible usefulness of the test in other fields. Typical steps in test development are shown in Fig. 3.

Typical Tests Constructed

Army General Classification Test (GCT, Forms 1a, 1b, 1c, 1d). This test of general ability is given at reception centers to all men able to speak and read English. It contains vocabulary, arithmetic and box counting items arranged in spiral omnibus form; it is graded to include all levels of mental ability. The GCT can be administered, including practice time, in one hour.

Mechanical Aptitude Test (Forms MA-1, MA-2, MA-3, MA-4). This test is designed to predict potential success in learning general mechanical duties. The types of items in the four forms vary: MA-1 includes mechanical movements, surface development and shop mathematics; MA-2 and 3 include mechanical information, surface development and mechanical comprehension; MA-4 includes tool recognition, mechanical comprehension and surface development. The first three forms may be scored by parts as well as by the total, and these part scores used in special selection.

Radiotelegraph Operator Aptitude Test (ROA-1, X-1). At the present time, because sufficient operators are not available to the Army, this test is given at reception centers to all men who score above 80 on the General Classification Test. ROA-1, X-1 contains 156 items, each consisting of two code patterns sounded in succession; the man tested is required to decide whether the two patterns are the same (mark YES) or different (mark NO). The items vary in difficulty, and each man tries all of them. The test is available on phonograph records and can be given in this way to groups of 100 to 150 men.

Achievement and Trade Knowledge Tests. Various educational achievement tests are used when there is need for men with knowledge of particular academic subjects. Trade knowledge tests are used to select for special training men sufficiently informed about particular jobs.

CHIEF, CLASSIFICATION AND REPLACEMENT BRANCH

PERSONNEL RESEARCH SECTION

Develops, evaluates, and approves modern psychological devices and related tools, including aptitude, trade and achievement tests and interviewing techniques for use in classification and assignment of enlisted and officer personnel throughout the Army; develops norms and standards and sets up technical manuals, Army regulations and directions for use of such tools; establishes policies with reference to classification problems; studies field requirements for which tests are to be devised; analyzes measurement of aptitudes and abilities to enable comparison of psychological characteristics of men in various branches and units of the Army, including the Army Specialized Training Program; develops tests for evaluating effects of training.

TEST CONSTRUCTION SUBSECTION

Plans and constructs selection, classification and achievement tests for all military personnel; studies the requirements of the field for which a test is needed; insures reliability and validity by necessary revision of tests.

STATISTICAL ANALYSIS SUBSECTION

Conducts studies of reliability and validity of tests; supervises scoring and analysis of experimental forms of tests; scales and calibrates tests; makes analyses of all tests in use; prepares aids to interpretation and use of test scores.

FIELD STUDIES SUBSECTION

Plans and executes field studies on classification of personnel; coordinates techniques with field requirements; obtains data on validity and reliability of classification tools.

EDITING AND REPORTING SUBSECTION

Edits tests; prepares and reviews technical manuals, Army regulations, memoranda, reports and directions for the use and interpretation of tests and other classification tools; provides and maintains library facilities for the Section.

SPECIALIZED TRAINING SUBSECTION

Directs and coordinates selection procedures for the Army Specialized Training Program; supervises administration of achievement tests and evaluation of student progress in colleges; supervises administration of classification tools developed for the ASTP; recommends new tests or revisions.

FIG. 1

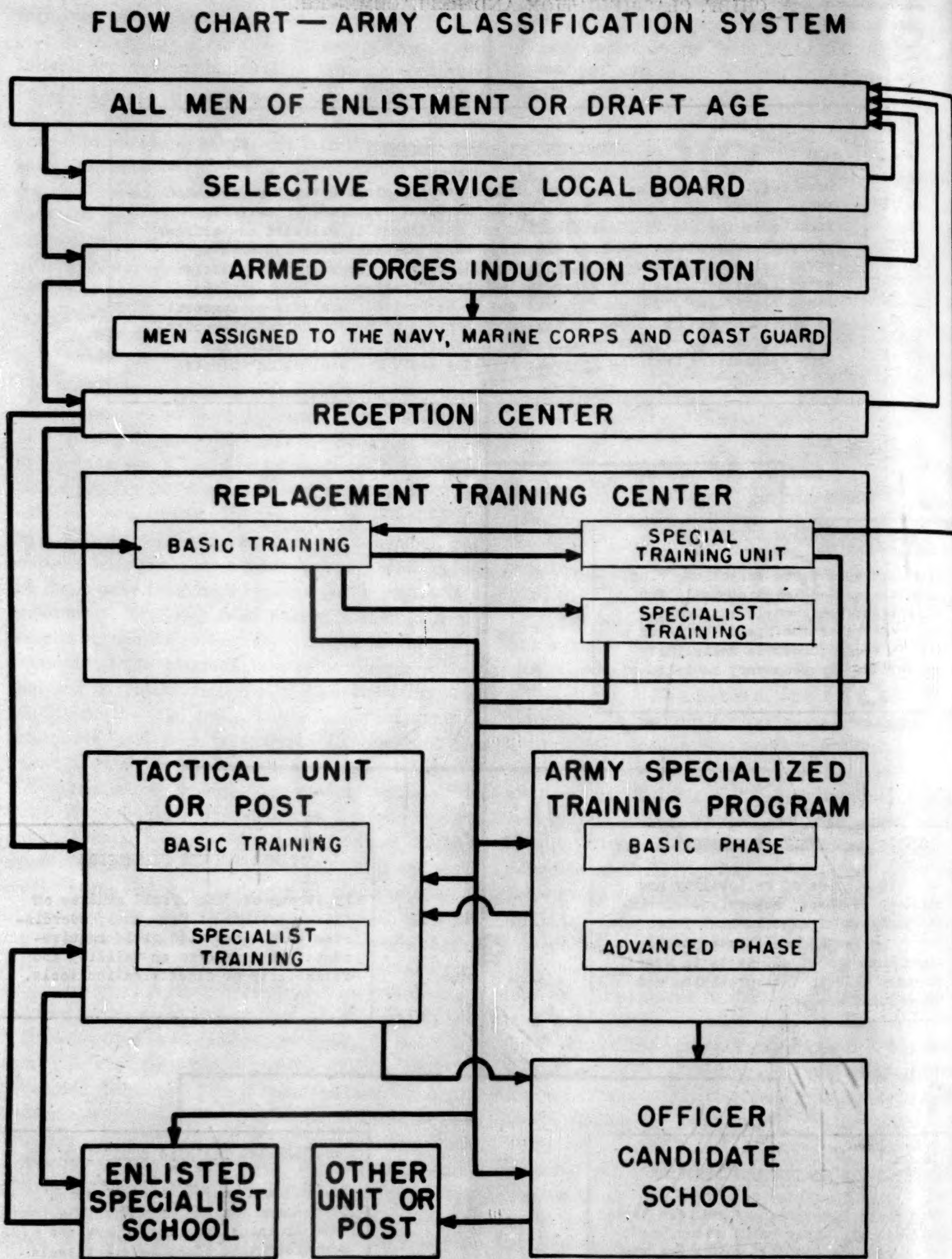


FIG. 2

This chart is intended to illustrate only the major agencies and organizations through which a man may pass or to which he may be assigned in the process of Army classification. Military necessity, local conditions, or special requirements of some arms or services make it impossible to show more than the usual stages involved.

DEVELOPMENT OF TESTS FOR CLASSIFICATION PURPOSES

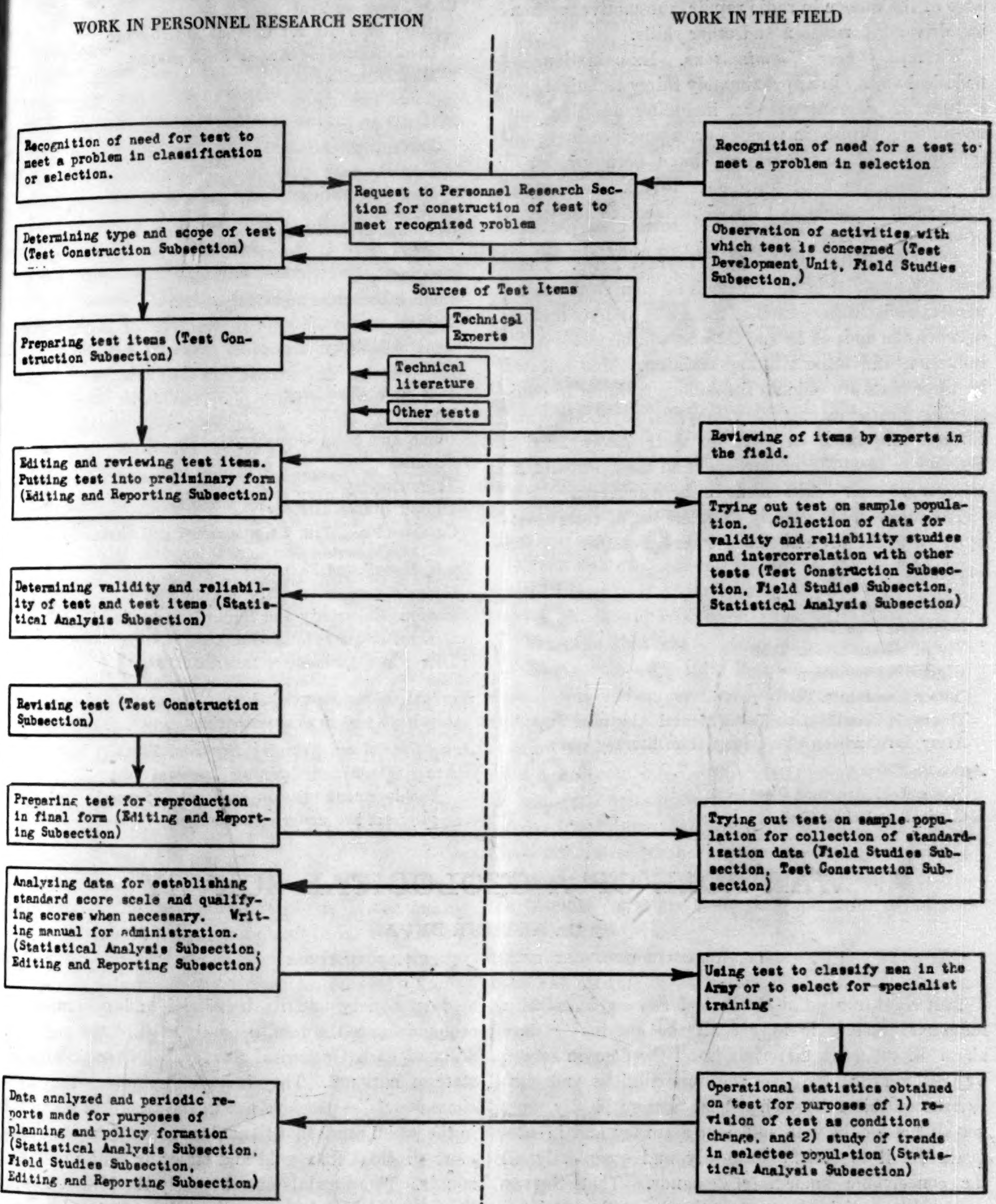


FIG. 3

Tests for the WAAC. Women applying for the WAAC are first given a mental alertness test to screen out the unfit. This test includes six types of items: information, vocabulary, arithmetic, judgment, proverb interpretation and comprehension of graphs and tables. A classification test is later given, in addition to special aptitude and proficiency tests. The aptitude tests used are Mechanical Aptitude, MA-4, Clerical Aptitude, CA-2, X-2, and the Radiotelegraph Operator Aptitude Test ROA-1, X-1. Written and oral

proficiency tests are used to check the technical knowledge of the women in radio repair, automotive mechanics, driver information and other skills.

Warrant Officer Examinations. Examinations of technical ability in approximately thirty technical specialties of warrant officers, including auditing and accounting, supply in various arms, engineering, photography and cryptography, have been prepared. These tests are kept up-to-date to take account of changes in methods and duties incident to the development of the Army.

Army Specialized Training Program Tests. These tests are to assist in the selection of men from among present enlisted personnel of the Army and young men between the ages of 18 and 22 who will be tested after induction and basic military training. Men selected by these tests are eligible for college training in engineering, medicine, chemistry, physics, psychology and foreign languages as part of their Army service. Further tests will be constructed and used periodically to measure their achievement in these subjects.

The following is a fairly complete list of tests developed up to the present time for Army usage:

Classification Tests
- General Classification Test
- Non-Language Test
- Visual Classification Test
- Higher Examination
- Officer Candidate Test
- Women's Classification Test (Mental Alertness Test)
- Army Information Sheet (minimum literacy test)

Aptitude Tests
- Mechanical Aptitude Test
- Clerical Aptitude Test
- Radiotelegraph Operator Aptitude Test
- Code Learning Test
- Battery of Tests for Combat Intelligence
  - Identification of Aerial Photographs
  - Map Identification
  - Route Tracing
  - Battle Maps
  - Perception of Detail
  - Map Reading
  - Map Orientation

Educational Achievement Examinations
- Algebra
- Arithmetic
- English Grammar and Composition
- French
- General History
- German
- Inorganic Chemistry
- Physics
- Plane and Solid Geometry
- Spanish
- Trigonometry
- United States History
- Combined Algebra, Trigonometry and Geometry

Trade Knowledge Tests
- General Automotive Information Test
- General Electricity and Radio Information Test
- General Radio Information Test
- Driver and Automotive Information Test

Warrant Officer Examinations
- About 30 technical examinations

Army Specialized Training Program Tests
- Army Specialized Training Program Test (achievement tests in each subject taught under the program are under construction)

WAR RÔLE OF A GEOLOGICAL SURVEY[1]

By Dr. ARTHUR BEVAN

STATE GEOLOGIST OF VIRGINIA, CHARLOTTESVILLE

THE chief rôle of a Geological Survey in modern industrial society is to get all the obtainable data about all the earth materials in all the domain served by that Survey. To meet the opportunities and obligations of this rôle, each official Survey ideally must get all these data with sufficient accuracy and in adequate detail to satisfy promptly and completely all the conceivable immediate demands. That Survey must also anticipate—even stimulate—the rational future needs of expanding mineral and related industries and interdependent society.

Those earth materials, which are so indispensable to the smooth functioning, and even the existence, of modern society and its industrial and governmental economies, are the familiar daily grist of the technical mills of each Geological Survey, whether provincial, state or national. They include at the base the "precious metals"—precious not in the technical sense but in the social sense that to modern society they are even more precious than gold and silver or rubies and diamonds. Those metals are obviously the birthstones of the "Age of Metals," as well as the structural framework for most industrial achievements. Included also among the grist of a Geological Survey are the essential nonmetals in great diversity, the priceless mineral fuels and sources of power, and, by no means least, the absolutely vital ground-water supplies. They are the functioning "corpuscles" in the "life blood" of modern industry.

[1] Address at the annual meeting of the Association of American State Geologists, Washington, D. C., February 19, 1943.

But it is not enough for a Geological Survey merely to act in the rôle of a general fact-finding agent on the broad stage of modern industrial relations. The interpretive biologist dissects tissues to the nucleus of the cell, or even more minutely, while the exploring physicist literally peers into the structure of the atom to perceive its component parts and its energy mechanisms. Each geologist, worthy of the name "research scientist," on the staff of an alert, aggressive Geological Survey must constantly strive to do likewise. At the same time, the Survey staff in part or as a whole must assemble, coordinate and interpret the results of that research into a body of usable and useful facts. No longer is it sufficient, as it may have been in days of old, to know what earth materials have been stored within the domain of the Geological Survey, and where, and in what probable quantity and of what possible quality. The present uses of those geologic resources must be widely understood and their potential industrial uses, to meet the needs of evolving society, must be envisioned as clearly and as completely as may be possible.

The staff of a modern Geological Survey must examine more or less minutely—take apart, so to speak—many raw mineral resources so as to determine the constituents and their significant geologic and chemical relations. For example, staff technologists must discover the kinds and characteristics of the unit components of coals, clays, even limestones, and of other complex earth materials. More than that, with this precise technical knowledge well in hand, they should experiment to the end that ways and means may be found to separate the constituents and recombine them into products of greater usefulness and hence of more value to society.

In summary, as I see it just now, the rôle of a Geological Survey has advanced rapidly from the qualitative stage of research to the quantitative theater of investigation. Early tendencies, entirely necessary and appropriate in those times, to general reconnaissance research in the field and in the laboratory have given way to precise, particular research in specialized fields through the use of all the available specialized techniques and apparatus. Pure geologic research, for a Geological Survey, has been supplemented to a considerable degree by emphasis upon greater practical usefulness. It should be stressed, however, that the two fields are not mutually exclusive, popular notions to the contrary notwithstanding, but that they are mutually interdependent.

In playing its proper rôle in modern society, a Geological Survey not only has the opportunity and obligation to make available to industry, in the broadest sense, all the useful facts about geologic resources, but it has also an unparalleled opportunity and an inescapable obligation to keep public interest stimulated and public opinion informed in regard to these resources. Some of us call this rôle of a Geological Survey "PEG"—alphabetical jargon for public education in geology. It is a responsibility and an opportunity of tax-supported Surveys even more than it is of educational institutions. The knowledge and attitude of the present and oncoming generations of public-minded citizens, administrative officials and statesmen in regard to the interrelated aspects of geologic resources will be of consequential significance in helping to shape the destinies of the post-war world and in making that world a better and more comfortable place in which to live and to create worthy results. The idea is well expressed in two recent statements: one by State Geologist Smith of Michigan when he said, apropos of PEG, that "geology should come 'down to earth' "; the other by Miss Newlon, of the West Virginia Geological Survey, when she emphasized one of the aims of their Survey to be that "every one in this State is going to know what geology is and what it's good for!"

At the risk of becoming wearisome in the emphasis upon PEG as part of the essential rôle of a Geological Survey, it should still be stressed in these times of rapid tempo that grave social dangers may lurk in the long-continued public lack of understanding, or even worse—misunderstanding, of the rôle of pure and applied geology in modern affairs. Examples ranging from local to national importance no doubt come readily to mind. Too many steps of progress in geological science, industrial development, governmental functioning and social evolution depend upon those influential public attitudes to permit us to dismiss them as of little concern to the research geologist, the teaching geologist and staff members of official Geological Surveys.

Most of you are probably asking by this time, "But what has all this to do with the rôle of a Geological Survey in time of war?" Only this: Wars make rapid and decisive shifts mandatory—not only in the military establishment but in the undergirding and supporting civilian activities. In an all-out, global war, such as the present conflict, many of those civilian shifts are sudden and drastic. In brief, Geological Surveys too have gone to war—in many ways and over a considerable period of time. In the field and laboratory work and in the strengthening of their staffs, most of them have been preparing, though probably without this particular objective in the forefront of their planning, to meet promptly the emergency demands that are now being made upon them by the armed services and by war industries. Some technical staff personnel have gone into the armed services

where their special knowledge and skills will be of the greatest use in the successful prosecution of the war; others remain on the local "home front" where the daily service they render is just as highly important and just as effective in the war efforts.

Illustrations multiply daily in the experience of each Geological Survey as to how dependent upon the broad base of geologic science—pure and applied—is the successful conduct of a large-scale modern war. In fact, the turn of the wheel of fortune in great measure is as closely related to geologic science as it is to military science, though the latter is without question the more directly involved and the more directly responsible. It is so obvious now as to be trite that this is a war of machines and instruments, of terrain and topography, of mineral resources and ground-water supplies—all geologic resources of the greatest importance. This is no minimization of man power, or of the value of brains compared with brawn, but under modern conditions they are not the unique force of ancient warfare. The unfortunate fact still remains, however, that the supreme value of geologic resources has not been clearly understood or readily accepted by all who are concerned with all the theaters of preparation, of potential conflicts of interest and of actual combat. "Too little too late" also has its dismaying applications here as well as elsewhere.

The war rôle of an efficient Geological Survey appears, therefore, to be primarily an accelerated continuance of its best peacetime methods. A decisive shift in emphasis upon the type of results to be obtained and their application—both in time and place—rapidly becomes necessary, or even mandatory. Some temporary measures will be desirable, but ultimate peacetime good may come from some of them. The war rôle of an official Geological Survey thus involves a shift in immediate objectives, a new setting of the sights and probably also a realignment of personnel.

In conclusion, we must never forget, or permit others to overlook, the facts that those Surveys are the great repositories of the most useful and diversified geologic and mineral resource data, that they are the users of the most modern field and laboratory techniques in their respective spheres, and that above all they have the technically trained, skilled personnel to make effectively the necessary conversion from peacetime scientific and industrial research to frontal attacks upon very important war problems. Obviously, the closer the cooperation with all other agencies having similar rôles, the more effective will be the contributions of the Geological Surveys toward the prompt and effective winning of this war. Unselfish continuance of such effective cooperation far into the post-war period should help to make another such war virtually impossible.

OBITUARY

ISAAC MCKINNEY LEWIS
1878–1943

ISAAC MCKINNEY LEWIS, professor of bacteriology in the University of Texas, died of a heart attack on March 12, 1943. He had suffered an attack in the summer of 1941, but, after a long convalescence, he had apparently fully recovered. He is survived by two brothers, Dr. Charles E. Lewis, of Waterville, Maine, and John R. Lewis, of Wolcott, Indiana. He never married.

Dr. Lewis, third son of Isaac R. Lewis and Margaret Jane (McKinney) Lewis, was born on September 21, 1878, on a farm in Jasper County near Rensselaer, Indiana. He had the misfortune never to know his father, who died in the May preceding his birth. He was devoted to his mother, who had been a teacher, throughout her lifetime and he gave her credit for instilling in him the desire to secure an education.

He attended the country school near his home and finished the eighth grade at the age of fourteen. By home study while working on the farm he prepared himself for the teacher's certificate, and at the age of seventeen he began teaching in his home township of Barkley. In 1897 he entered the Indiana State Normal School. His work there was interrupted by trouble with his eyes following measles, and by the necessity of earning his expenses, but he was finally able to finish in 1904. He entered the University of Indiana in the fall of the same year and from this institution he received the B.A. in 1906, the M.A. in 1907 and the Ph.D. in 1909. During the year 1908–09 he was instructor in botany in New Hampshire State College and assistant botanist in the experiment station. In September of 1909 he came to the University of Texas to be instructor in botany and to initiate work in bacteriology. He rose through the successive ranks to professor in 1919. In 1918–19 he was a captain in the Sanitary Corps, U. S. Army, stationed at the Yale Army Laboratory School. He was designated as research professor in 1938–39. For a number of years he taught both botany and bacteriology, but the development under his leadership of the work in bacteriology was such that for the past fifteen years this field occupied his entire time. Throughout his career, however, he retained an intense loyalty to the parent science of botany.

As a man he was unselfish, kindly and modest almost to the point of shyness, with a lively sense of humor

and a ready wit. Friends, colleagues, students found him easily approachable, sympathetic, and in times of trouble generous with financial aid.

As a teacher Dr. Lewis was excellent. His lectures, sound always in matter, were invariably well organized, well presented and highly interesting. Students trained under him were warmly welcomed if they transferred to another institution. Among his associates it has been a common experience to be told by former students that Dr. Lewis was the best teacher they had during their college career, either at the University of Texas or elsewhere.

He was a member of Sigma Xi, the American Association for the Advancement of Science, the Botanical Society of America, the American Phytopathological Society, the American Microscopical Society (vice-president, 1932), the Society of American Bacteriologists and the Texas Academy of Science. In the Society of American Bacteriologists he was a member of the national council from 1940 to 1942. He was the organizer of the Texas Branch of that society, and at the time of his death was serving his second term as its president.

In productive scholarship Dr. Lewis was painstaking and tireless. Few of his publications show joint authorship, for he preferred to work alone, even to the point that he prepared himself most of the media and glassware. Each experiment he repeated many times over before he accepted the results. It is plainly evident from a consideration of his publications that his primary interest was in the pure and fundamental aspects of the subject. And the caliber of the work done by him is attested by the letters of commendation which he received from foreign and American bacteriologists. At the time of his death he was engaged in the preparation of the manuscript for a book on the bacterial cell.

O. B. WILLIAMS

RECENT DEATHS

DR. HENRY SEELY WHITE, professor emeritus of mathematics of Vassar College, died on May 20 at the age of eighty-two years.

JOHN S. STONE, from 1920 to 1935 a member of the department of research and development of the American Telephone and Telegraph Company, died on May 20 in his sixty-fourth year.

ELIZABETH T. PLATT, since 1937 librarian of the American Geographical Society of New York, died on May 22 at the age of forty-three years.

SCIENTIFIC EVENTS

EXPLORATIONS AND FIELD WORK OF THE SMITHSONIAN INSTITUTION

THE annual report for 1942 by Dr. Charles G. Abbot, secretary of the Smithsonian Institution, gives the following account of explorations and field work carried out during the year:

Explorations, often in out-of-the-way corners of the earth, have always formed a major part of the institution's program for the "increase and diffusion of knowledge." Although world conditions during the past year have made it either impracticable or undesirable to send out many of the expeditions that normally would have taken the field, nevertheless, even under the present unfavorable conditions it was found possible to carry on some field work in connection with researches previously commenced.

In astrophysics, field observers carried on their study of the intensity of solar radiation at the three Smithsonian observing stations on Mount Montezuma, Chile, Table Mountain, Calif., and Burro Mountain, N. Mex. Observations were made on every suitable day throughout the year, and the results were transmitted to Washington where they are used in investigations on the variability of solar radiation and on the relation between this variability and the earth's weather.

In geology, Dr. W. F. Foshag directed an expedition in cooperation with the U. S. Geological Survey with the purpose of studying certain strategic-mineral resources of Mexico. Dr. Charles E. Resser continued his studies of Cambrian rocks from Montana into the Canadian Rockies, obtaining much new information and many desirable specimens pertaining to the ancient Cambrian period. Dr. G. Arthur Cooper made large collections of Carboniferous and Permian fossils in Texas and Oklahoma, including much material hitherto lacking in the National Museum collections. A third expedition to the Bridger Badlands of southwestern Wyoming in search of extinct vertebrate animals was directed by Dr. C. Lewis Gazin; many interesting exhibition and study specimens were brought back to the museum, including a 1,270-pound slab containing 12 or 13 fossil turtles.

In biology, Dr. E. A. Chapin visited the island of Jamaica to continue his studies of the insect fauna with special reference to the termites. Large collections of the plants of Cuba were made by C. V. Morton, who spent two months on the island in botanical field work accompanied by two Cuban Government botanists.

In anthropology, Dr. T. D. Stewart visited Peru to make a scientific examination of the skeletal remains exposed in the numerous ancient cemeteries of that country; he also gathered information on the skeletal collections in Peruvian museums. As an extension of Smithsonian cave explorations in the Big Bend region of Texas, Walter W. Taylor investigated caves in the region of Ciénegas, Coahuila, Mexico, some twenty caves being excavated in the course of the work. Dr. Frank H. H. Roberts, Jr., conducted archeological investigations near the town of San Jon, eastern New Mexico, revealing four types of projectile points from four stratigraphic horizons, the

oldest type in association with an extinct bison and with indications that it may be contemporaneous with the Folsom horizon. Dr. William N. Fenton recorded Iroquois songs in New York State and Canada in cooperation with the Division of Music in the Library of Congress.

THE PATENT INDEX FOR CHEMICAL ABSTRACTS

THE chairman of the Science-Technology Group of the Special Libraries Association has sent the following announcement to SCIENCE:

Some years ago a committee of the Science-Technology Group of the Special Libraries Association started an index of the patents for *Chemical Abstracts* by country and by patent number thereunder, to conform with the present index issued yearly since 1936 by *Chemical Abstracts* itself. Many of the librarians, particularly those working with patent literature, felt that this project was extremely worthwhile and that the publication would be of interest to many firms working with chemical patents, as well as to libraries.

The Patent Index for *Chemical Abstracts*, 1907–1936, is practically completed. The patents for the year 1936 have been included because the next decennial index will carry a patent number index beginning with 1937. Thus, this publication will serve to make the index of patents to *Chemical Abstracts* complete.

Since the material is chiefly a numerical listing, the type-setting for which would be extremely expensive, it seemed to the committee that some form of photographic reproduction would be the most satisfactory method of publication and, for this reason, they have arranged with Edwards Brothers, Inc., of Ann Arbor, Mich., who are publishing Beilstein and a number of other German scientific and technical books for the Alien Property Custodian, as well as the Library of Congress Catalog of Printed Cards, to consider the practicability of publishing this index by the photo-offset process. It is estimated that the index will fill approximately 500 pages, the same page size as *Chemical Abstracts*.

Since the demand for this publication is definitely limited and may even be insufficient to warrant publication, it is suggested that any one who would be interested in purchasing one or more copies of the index should write either to Miss Elsie L. Garvin, chairman of the Science-Technology Group of the Special Libraries Association, at the Eastman Kodak Company Research Library, Kodak Park Works, Rochester, N. Y., or directly to Edwards Brothers, Inc., of Ann Arbor, Mich.

THE TRANSACTIONS OF THE ROYAL SOCIETY OF SOUTH AUSTRALIA

WE learn from T. T. Colquhoun, honorary secretary of the Royal Society of South Australia, that at a recent meeting of the council it was decided that, for various reasons, it was desirable to suspend general dispatch of the *Transactions* overseas for the duration of the war. It was felt, however, that a skeleton distribution should be maintained in order that the publication may be available to research workers in the United States. A small list of learned societies and libraries on the exchange or subscription list was therefore drawn up and it was decided to forward the *Transactions* to these as they are issued. These societies are:

American Chemical Society, Columbus, Ohio.
American Microscopical Society, Manhattan, Kansas.
Arnold Arboretum, Harvard University, Jamaica Plain, Mass.
Botanical Gardens, St. Louis, Mo.
Field Museum of Natural History, Chicago, Ill.
Marine Biological Laboratory, Woods Hole, Mass.
National Academy of Sciences, Washington, D. C.
New York Public Library, New York, N. Y.
Smithsonian Institution, Washington, D. C.
U. S. Department of Agriculture, Washington, D. C.
U. S. Geological Survey, Washington, D. C.
University of California, Berkeley, Calif.

RARE CHEMICALS

THE following chemicals are wanted by the National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Dearborn and Federal Streets, Chicago, Ill.:

1. Chromium wire or ribbon
2. Sodium hypophosphate or any acid sodium hypophosphate
3. 2,4,6-trisulphydryltriazine
4. alpha-methyl-vinyl-methyl-ketone
5. Ornithine
6. Di-n-propyl aminoethyl alcohol
7. Dibromoacetic acid
8. Glyoxylic acid
9. Long chain sulfonium, such as lauryl diethyl sulfonium iodide
10. Desoxy ribose
11. Triethyl phosphene
12. Pure arsenic
13. Cupric or cuprous oxide (pure)
14. Cupric or cuprous sulfide (pure)
15. Molybdenum tetrabromide
16. Acetyl sulfanilic chloride
17. Lithium lactate
18. Orthoform (new and old)

THE MOBILIZATION OF SCIENCE

THE following resolution was passed on May 8 by the War Policy Committee of the American Institute of Physics concerning the Kilgore bill.

WHEREAS, The American Institute of Physics, representing the physicists engaged in all branches of activity in their profession, has made studies and surveys to determine the extent to which physicists are engaged in and contributing to the war effort; and

WHEREAS, The facts thus found show that practically all physicists are now applying themselves to the advancement of war research, war industry, and training personnel for the war effort; therefore be it

Resolved, That the War Policy Committee of the American Institute of Physics, while conceding that there is room for improvement, nevertheless maintains that physics is well mobilized and is effectively working on the problems arising out of the war through such agencies as the Office of Scientific Research and Development; the laboratories of industry and of the various branches of the armed services and other government agencies; and in the laboratories and classrooms of our educational institutions where large numbers of personnel are being trained for war service; and be it further

Resolved, That the War Policy Committee of the American Institute of Physics regards the proposals now before Congress in the forms of Senate bill No. S. 702 and House bill No. H.R. 2100 as not well conceived to increase the productivity of physics in the war, but rather tending to disorganize and retard the effective work now being done.

PRESENTATION OF THE CHARLES FREDERICK CHANDLER MEDAL

THE Chandler Medal for distinguished service in science was presented on May 24 at Columbia University to Dr. Willard H. Dow, president and general manager of the Dow Chemical Company, Midland, Mich. The medal was awarded in recognition of "his dynamic and successful leadership in the American chemical industry. In addition to his accomplishment in expanding a chemical industry which depended upon Michigan salt brines, his daring enterprise in the direction of the extraction of bromine and of magnesium from sea water, the production of synthetic plastics and synthetic rubber has attracted world-wide attention." After the presentation Dr. Dow delivered the medal address, which was entitled "Rediscover the Rainbow."

Dr. Dow was born in Midland on January 4, 1897. He was graduated from the University of Michigan with the degree of bachelor of science in chemical engineering in 1919. He received the honorary degree of doctor of science from the Michigan College of Mining and Technology in 1939 and the honorary degree of doctor of engineering from the University of Michigan in 1941.

His career as chemical engineer began in 1919 with the Dow Chemical Company. He became assistant general manager in 1926, and has been president and general manager since 1930. He is president of the Ethyl-Dow Chemical Company, which operates a plant for the recovery of bromine from the sea at Kure Beach near Wilmington, N. C. In addition he is president of the Midland Ammonia Company and of the Dow Chemical Company of Canada, Limited. He is a director of the American Chemical Society and a member of the Advisory Board of the Chicago Chemical Warfare Procurement District.

The Chandler Medal was established in 1910 in honor of Professor Charles Frederick Chandler, pioneer in industrial chemistry and a founder of the American Chemical Society. It is awarded annually from a special fund administered by the trustees of Columbia University. There have been nineteen previous recipients of the medal. The last award was made in 1942 to two brothers outstanding in chemical science, Dr. Robert R. Williams, chemical director of the Bell Telephone Laboratories of New York, and Professor Roger J. Williams, of the University of Texas.

Professor Arthur W. Thomas was chairman of the committee of award. Other members were Professors Leo H. Baekeland and Arthur W. Hixson.

SCIENTIFIC NOTES AND NEWS

DR. J. MURRAY LUCK, secretary of the Pacific Division of the American Association for the Advancement of Science, telegraphs that the Corvallis, Oregon, meeting, which was to have been held from June 14 to 19, has been cancelled. He states that unanticipated difficulties in the arrangements for lecture rooms and meals necessitated this action. The transfer of the meeting to another institution did not prove feasible.

IN recognition of distinguished attainment and outstanding contribution to the advancement of cooperative research in fundamental geophysics, Dr. Oscar Edward Meinzer is the recipient of the fifth annual award of the William Bowie Medal by the American Geophysical Union.

AMONG the medals presented on May 19 by the National Institute of Social Sciences, a gold medal was given to Dr. Edwin G. Conklin, of Princeton University, president of the American Philosophical Society. The citation reads: "In recognition of your distinguished service for the benefit of mankind through your fundamental contributions to science and education. Your lifelong studies and attainments in the fields of biology and zoology acclaim you among the truly great throughout the scientific world to-day."

THE Jacob F. Schoellkopf Medal for 1943 of the Western New York Section of the American Chemical Society has been presented to Raymond R. Ridgway, associate research director of the Norton Company, Chippewa, Ontario, in recognition of the development of boron carbide as an industrial abrasive.

THE Willard Gibbs medal, founded by William A. Converse, was presented on May 20 to Dr. Conrad Arnold Elvehjem, professor of biochemistry at the University of Wisconsin, by the Chicago Section of the American Chemical Society at a dinner meeting at the Medinah Club of Chicago. The medal is awarded annually in special recognition of "eminent work in and

original contributions to pure or applied chemistry." The recipient is chosen each year by a jury appointed by the Chicago section. The achievements for which the medal was awarded to Dr. Elvehjem are given in the issue of SCIENCE for February 19. Dr. Roy C. Newton, chairman of the Chicago section and vice-president of Swift and Company, spoke on "The Willard Gibbs Medal, an Inspiration to Chemists." Dr. C. Glenn King, scientific director of the Nutrition Foundation, spoke on "The Medalist, His Achievements," and Dr. Per K. Frolich, president of the American Chemical Society, presented the medal. Dr. Elvehjem's address was entitled "The Nutritional Significance of the Newer Members of the B-Complex."

AT the annual dinner meeting of the Board of Directors of the National Science Fund of the National Academy of Sciences held in New York City on May 19, Dr. Charles Huggins, professor of surgery at the University of Chicago, was presented with a $2,000 award, given by Dr. Charles L. Mayer and administered by the National Science Fund. The award was made for the most outstanding contribution during 1942 to present-day knowledge of factors affecting the growth of animal cells with particular reference to human cancer, and as a new type of prize for the advancement of fundamental scientific research administered under a new type of philanthropic foundation. It was announced by Dr. William J. Robbins, chairman of the fund, that a second Charles L. Mayer Award of $2,000 in the same field will be made in 1943 and that entries and recommendations for the consideration of the Advisory Committee should be in the office of the National Science Fund, 515 Madison Avenue, New York City, by January 15, 1944. He also reported that early announcement would be made of a $4,000 award to be offered for a significant study in the field of physics.

DR. CHARLES FREDERICK BOLDUAN, having reached the civil service age limit, will retire on June 1 after serving for twenty-nine years as director of the Bureau of Health Education of the Municipal Department of Health of New York City which he organized and of which he was the first director. Fellow-employees and friends in the medical profession outside the department gave a testimonial dinner on the evening of May 13. The speakers included Dr. James Alexander Miller, chairman, and Dr. E. H. Lewinski-Corwin, executive secretary of the committee on public health relations of the New York Academy of Medicine; Dr. Haven Emerson, member of the City Board of Health and former Health Commissioner, and bureau heads of the Department of Health.

A TESTIMONIAL dinner was tendered by various institutions with which he has been associated to Dr. J. Stanley Kenney, president of the Medical Society of the County of New York, on May 19. The speakers included Dr. Thomas A. McGoldrick, president of the Medical Society of the State of New York; Dr. Nathan B. Van Etten, past president of the American Medical Association; the Honorable Joseph V. McKee, formerly judge of City Court in the Bronx and formerly mayor of New York City; Dr. Edward M. Bernecker, Commissioner of Hospitals; Dr. Ernest L. Stebbins, Commissioner of Health; Dr. Alexander Nicoll, Lieutenant Colonel, World War I, commanding officer of Red Cross Hospital Unit H of Fordham Hospital, with which organization Dr. Kenney served in France during the last war. Dr. John J. McGowan, medical director of Fordham Hospital, was toastmaster.

SMITH COLLEGE conferred the doctorate of science at its commencement exercises on May 20 on Helen Woodard Atwater, of the U. S. Department of Agriculture, editor of the *Journal of Home Economics*, and on Dr. Marion Hines, associate professor of anatomy in the School of Medicine of the Johns Hopkins University. The degree was conferred on Miss Atwater for "devoting her life to the development of national interest in a better knowledge of the value of food," and on Dr. Hines in recognition of her "brilliant researches in the anatomy and physiology of the nervous system."

C. R. DE LONG, consulting chemical engineer, was elected president of the Chemists Club, New York City, at its annual meeting on May 5. Mr. De Long succeeds Walter S. Landis, vice-president of the American Cyanamid Company.

THE following officers of the University of Southern California Chapter of the Society of the Sigma Xi for the year 1943 were elected at a meeting of the chapter on May 11: *President*, Dr. Francis Marsh Baldwin, zoology; *Vice-president*, Dr. Arthur W. Nye, physics; *Secretary*, Professor W. W. Smith, bacteriology, and *Treasurer*, Professor Sidney Duncan, engineering. At this meeting the class for 1943 was initiated and a lecture was delivered on "Tropical Diseases and the War" by Professor John Kessel, of the department of bacteriology.

LORD MORAN was re-elected on April 19 president of the Royal College of Physicians of London.

DR. J. EDWARD HOFFMEISTER, professor of geology at the University of Rochester, has been named dean of the faculty of the College of Arts and Science.

DR. JOHN L. SYNGE, F.R.S., professor of applied mathematics and head of the department of the University of Toronto, will join the faculty of the Ohio State University on July 1 as chairman of the department of mathematics. He succeeds Professor Harry W. Kuhn, who retires this summer. Professor Kuhn

has been a member of the university staff continuously since 1901, and has been chairman of the department of mathematics since 1926.

DR. SAMUEL SOSKIN, director of metabolic and endocrine research at the Michael Reese Hospital, Chicago, has been appointed medical director. This inaugurates a new program of medical teaching at that institution. It will be developed first on an intramural basis, and will then gradually merge into postgraduate teaching available to the medical profession at large. It is hoped that the program will be sufficiently advanced by the end of the war to help to meet the demand for refresher courses for physicians now in the armed forces. The hospital is able to draw upon its Research Institute and extensive full-time staff for teachers of the basic sciences to supplement its clinical teaching staff. Dr. Soskin, who will organize the teaching faculty of which he will be dean, originally came to the hospital from the University of Toronto, where he worked with the late Professor J. J. R. Macleod. He is also professorial lecturer in physiology at the University of Chicago.

DR. STERLING BRACKETT, assistant professor of public health in the School of Public Health of the University of North Carolina, has been appointed malariologist in the Stamford Research Laboratories of the American Cyanamid Company.

DR. ARNOLD D. WELCH, who since June, 1940, has been in charge of the pharmacological research laboratories of the Medical-Research Division of Sharp and Dohme, has been made director of research for this division. He will continue to direct the general activities of the pharmacological and nutritional laboratories. Dr. Karl H. Beyer, who recently joined the Medical-Research Division, has been appointed assistant director of pharmacological research. Dr. Beyer will have the cooperation and assistance of Dr. Paul A. Mattis, who is actively supervising the histological and toxicological work of the department and who will also serve as assistant department manager.

ALFRED C. WEED, curator of fishes at Field Museum of Natural History, Chicago, has retired.

DR. T. C. SCHNEIRLA, associate curator of animal behavior at the American Museum of Natural History, has been appointed editor for the Section of Animal Behavior of *Biological Abstracts*.

PROFESSOR ARTHUR M. CHICKERING, Albion College, expects to spend the greater part of the coming summer in the Museum of Comparative Zoology of Harvard College engaged in the study of Panamanian spiders.

DR. HERBERT M. COBE, of the department of bacteriology of Temple University Professional Schools, Philadelphia, has been granted leave of absence for the duration of the war to accept a commission as First Lieutenant in the Army of the United States. He is stationed at Fort Devens, Mass.

THE James Arthur Lecture of the American Museum of Natural History on the evolution of the human brain was given on May 27 by Dr. James W. Papez, professor of anatomy at Cornell University. He spoke on "Ancient Landmarks of the Human Brain and Their Origin."

SIR LAWRENCE BRAGG, Cavendish professor of experimental physics in the University of Cambridge, left late in April for Sweden, where he planned to give a series of scientific and popular lectures under the auspices of the British Council. He will give popular lectures on "Seeing Ever Smaller Worlds" and on "Metals," and scientific lectures on "X-Ray Optics," on "The Structure of a Protein" and on "The Strength of Metals."

THE Southeastern Section of the Botanical Society of America, acting through its committee on activities, has cancelled the 1943 summer meeting, normally held in June. The membership voted unanimously, by mail, to retain all present officers until a meeting is next held. These officers are: Dr. O. E. White, University of Virginia, *Chairman;* Dr. K. W. Hunt, College of Charleston, *Secretary;* Dr. S. L. Meyer, University of Tennessee, Dr. F. A. Wolf, Duke University, and Dr. G. T. Weber, University of Florida, *Committee on Activities.*

DISCUSSION

IS WAR THE PROGENY OF SCIENCE, OR SCIENCE THE PROGENY OF WAR, OR ARE BOTH OF THESE SUPPOSITIONS FUNDAMENTALLY FALSE?

MANY answers are given as to what has brought about the present crisis. Most of them are wrong. Some say pressure of population! Wrong! To see how wrong it is only necessary to call attention to the fact that all the aggressors are trying to stimulate the birthrate in their countries. Others say needed access to raw materials! Wrong! for there has never been any lack of such access for non-aggressor nations.

Denmark had the highest standard of living in Europe and she had almost no raw materials but had no trouble in getting what she needed through the normal processes of trade. Some say that science must be held responsible, since it has made possible the development of the instruments of destruction and created the conditions that bring on these clashes. They say that man's moral development has not kept pace with his scientific progress. Therefore call a halt to science till morals catch up.

That is how one group talks. Are they right or are they wrong? If they are right, then all institutions of higher learning in the world are wrong in the whole of their objectives, for they consider it their main job to increase and disseminate knowledge, which is only another word for science. They look upon this as mankind's greatest need.

But there is another group that turns the foregoing statement around and asserts, not that science is responsible for war, but that war is responsible for science—that science is the progeny of war, that war has stimulated all the great inventions. Now, it has in fact stimulated some of them, but a reputable writer has recently gone so far as to make the statement that in view of the conditions brought about by modern science a man's life was safer a few hundred years ago than it is to-day.

That is an interesting and an arresting statement which one might possibly think was true if he had somehow been kept in ignorance of the *statistical fact* that the average span of life for all of us to-day is about sixty years, whereas only 150 years ago it was about thirty years.

Again, I have seen it asserted that war begat science because it was the discovery of gunpowder that first taught man that he could get enormous power out of chemical combinations. That assertion also might make a convert of one who was completely ignorant of the following whole series of historic facts: (1) That gunpowder was invented and first used only for peaceful purposes about 850 A.D. by the most peaceful people on earth; (2) that there is no record that it was in any way applied to warfare until 600 years at least after its invention; (3) that the wide application of chemical forces to the relief of human muscles for doing the world's work is a phenomenon of essentially the past 150 years; (4) that that application first began on a serious scale about 1800 A.D., 1,000 years after the invention of gunpowder, with the appearance of Watt's steam engine; (5) that the industrial revolution neither did nor could come about until after the discovery and development in the two centuries between 1600 A.D. and 1800 A.D. of the principles of Galilean-Newtonian mechanics, of which it was itself an outgrowth; and these had nothing whatever to do with war; (6) that I estimate that more than 99 per cent. of the world's development and application of science up to 1914 was actually made, not in the midst of wars, but in the hundred years from 1814 to 1914—in that very century that was so unusually free from major wars that it is generally known as the century of the "Pax Britannica"—a peace made possible because of the beneficent policing of the world by the British fleet; (7) that there is not the slightest *historic* warrant, taking history as a whole, for calling science and technology the offspring of war; (8) that the opposite assertion is a perfect illustration of the fundamental error of getting the cart exactly before the horse.

ROBERT A. MILLIKAN

THE "SCIENCE MOBILIZATION BILL"

THE introduction of this bill, S.702,[1] is a significant event. Senator Kilgore is to be congratulated for appreciating the practical values of science and for being a pioneer in a highly important field of political action. However, only a narrow body of opinion was influential in the preparation of the bill. It professes to advance "the full development and application of the Nation's scientific and technical resources." These have been created by the joint efforts of research workers, educators, inventors, engineers, manufacturers, mechanics, etc. Senator Kilgore and Representative Wright Patman, sponsor of the same bill in the House, H.R. 2100, have courteously circularized members of some of these groups requesting comments.

Opinion of experts is strongly against the bill. Professor William S. Carpenter, chairman of the department of politics in Princeton University, may be quoted: "It is a bill which should be opposed by every scientist and every student of government." Leading objections may be summarized under three heads:

(1) In times past, existing Federal agencies which are carrying on excellent scientific and technical work have been hampered by insufficient funds. Congress ought to consider giving more adequate support to them before undertaking the commitments of S.702—which are in some measure competitive with existing bureaus.

(2) It is the free man's tradition that every proposed law should be examined as to its potential misuse. Clauses in the bill can establish a new "pork barrel" for the benefit of localities rather than of science, subject to arbitrary Executive disposition. Where a Congressman could have no more than a river dredged or a post office built, the proposed new Office of Scientific and Technical Mobilization

[1] SCIENCE, May 7, 1943, pp. 407–412.

might strengthen the party loyalty of a wavering area by planning development of low-grade ore deposits, planting an experimental crop or starting a Federal school.

(3) The bill ought to satisfy the political element interested in suppressing private enterprise and substituting government by administrators who "serve at the pleasure of the President." Not the least contribution to scientific achievement through the centuries has been made by statesmen who have planned and fostered political freedom. Only in a free society can the cooperations and initiatives flourish which generate the unplanned and unforeseeable major advances of science. The bill gives the new office power "To make, amend, and rescind appropriate rules and regulations to carry out the purposes of this Act and all the powers and duties vested in the Office, which rules and regulations shall have the force and effect of law." Since one of the declared purposes is "to promote the full and speedy introduction of the most advanced and effective techniques . . ." and another is "to assemble, coordinate, and develop for use, in the public interest, all scientific and technical data and facilities . . .," there is here a clear avenue for governmental interference with every detail of laboratory, classroom and shop. The assertion of Dr. K. A. C. Elliott and Dr. Harry Grundfest[2] that the bill should not be attacked on the ground of "regimentation" and their comparison of the powerful new office with such limited agencies as the Public Health Service seem naive.

But destructive criticism of this bill is not enough. Science and expertness generally are affected with a public interest. If scientists as individuals persist in ignoring the social responsibilities of science, there evidently is serious risk that objectionable political measures will be improvised. In universities and scientific organizations the innocently selfish leadership of specialists must be supplemented by leadership aware of the world.

JOHN Q. STEWART

PRINCETON, N. J.

STARS IN "AMERICAN MEN OF SCIENCE"

THE note on stars for American men of science by Dr. S. O. Mast appearing in SCIENCE for May 21, 1943, was read with interest.

The suggestion by Dr. Mast that we ask for a vote on the stars in "American Men of Science" by those concerned is a good one. This has already been done. All those who are included in the sixth edition of the directory were asked whether the stars should be included, and a majority voted for their continuation. A minority of those who replied suggested various ways by which the method might be revised. Accordingly, the American Association for the Advancement of Science was asked to appoint, and appointed, a committee, to take up the question, but owing to the war emergency this committee has not been able to meet. In order that there may be continuity it has been decided to use the same method as in previous editions. When the eighth edition comes up for editorial consideration it is hoped that this committee may be able to function, and that the editor be advised as to the best method to carry out the voting.

Much discussion has appeared in SCIENCE and in earlier editions of the directory in regard to the stars. It has been pointed out that there are advantages and disadvantages; but up to the present time, the advantages have appeared to overshadow the disadvantages.

Election to the National Academy of Sciences takes care of rather a small group of scientific workers and the stars in "American Men of Science" make possible a wider recognition of leaders in science in their respective fields.

JAQUES CATTELL,
Editor, American Men of Science

AUTOBIOGRAPHY IN A DEMOCRACY

IN SCIENCE of February 19 under the title "What Price Glory" Professor Warren T. Vaughan of Richmond, Virginia, discusses in an entertaining way the inequal quality and length of many of the sketches which make up that indispensable volume, "Who's Who in America," while in the current SCIENCE (May 21) under the caption "Class Distinction Among American Men of Science" the method of starring 1,000 leading scientists by a sort of popular vote as done in the past five editions of "American Men of Science" is ridiculed by Professor S. O. Mast, of Johns Hopkins University.

Albeit these criticisms have their value as a part of current notation and opinion, yet they need not be taken over-seriously. The compilation of these volumes is a severe task; they are gotten out hurriedly. The publishers must and in a way may fairly depend on the *en masse* result. Both the participants and subscribers find that the final result is effective, meeting the many thousand ever-varying individual uses and needs. All is like the majestic flow of some great river, the Mississippi, for instance, as I remember it when long since doing river and harbor work below St. Louis. "Mark twain"! Certainly we see that those who have reached great distinction may well show a most becoming modesty and shorten their sketches, the main facts of their lives and their achievements being well known to all. Then too, there are facts of importance not easily brought into the average sketch. All of us work forward towards some greater objective and goal, and it must often prove difficult to set forth

[2] SCIENCE, April 23, 1943, p. 376.

facts and problems within the limits available. For myself, I'd like to call out from the mountain top the unequalled educational value of the *Fossil Cycad National Monument* as often and clearly told in SCIENCE. Surely the biographic approach by the law of averages has validity and convenience too. The "International Who's Who" is in its brevity of form in no wise an exception.

G. R. WIELAND

YALE UNIVERSITY

QUOTATIONS

MOBILIZING SCIENCE

THOUGH the public has paid little attention to Senator Kilgore's bill which would set up an Office of Scientific and Technological Mobilization, few recent proposals have been the subject of more controversy. Senator Kilgore wants his proposed office not only to draft all research scientists but to develop science and technology, encourage inventors and guide the President and Congress in scientific matters. The Army, the engineering societies, the trade associations and the directors of industrial research laboratories oppose him almost unanimously. On the other hand, many university professors, some of the higher officials of the War Production Board and a few corporation executives, among them Henry J. Kaiser, see merit in his bill.

Despite assertions to the contrary, scientists and technologists are not fully mobilized. So far as private research is concerned, industry has been left alone, so that we have much competition in the development of plastics, substitutes, processes for making alcohol, synthetic rubber and high-octane gasoline, and ten thousand other items. Except for the Office of Scientific Research and Development under Dr. Vannevar Bush, we have done virtually nothing to unify government, university and industrial laboratories to meet new war needs. Fundamentals are usually avoided. Yet it is out of fundamentals that new procedures emerge, as we have learned from the uses to which the vacuum tube, photoelectric cells, radio, x-rays have been put. The basis for all these was laid by independent scientists and inventors, who too often were rebuffed.

The proposal that Senator Kilgore has made deserves a fair hearing of Congress. Possibly stronger safeguards against the regimentation of industrial research are called for, and possibly Dr. Bush's method of contracting with university and industrial research laboratories for the solution of specific military problems may be just as effective as mobilizing the key research men in the country. Certainly corporations which are engaged in strikingly original and promising work or which are attacking fundamentals should be left alone. Establish Senator Kilgore's office with proper safeguards and it will have its uses as an independent organization which, like the Bureau of Standards or the United States Public Health Service, will conduct research on its account in fields now ignored, with industry pursuing its own way.—*The New York Times.*

SCIENTIFIC BOOKS

OBJECTIVE MEASUREMENT

Objective Measurement of Instrumental Performance. By JOHN GOODRICH WATKINS. 88 pp. Appendix. New York: Bureau of Publications, Teachers College, Columbia University. 1942. $1.60.

DR. WATKINS painstakingly seeks for a measuring stick to be used for the evaluation of playing ability on a musical instrument. He calls attention to the general acceptance of the consideration of musical ability as an innate capacity and deplores the lack of criteria for achievement other than teacher's marks which are known to be quite unreliable. The few sporadic attempts in the construction of achievement tests were found to be limited to sight-singing and vocal performance, and the evidence indicates that no group test of musical achievement has as yet been constructed with the degree of reliability necessary for individual differentiation.

It would have been desirable to indicate in the title of the book the fact that this test is limited to the playing on the cornet, particularly in view of the author's expressed desire for real scientific objectivity.

The study has two major objectives: (1) To determine the possibility of measuring objectivity achievement on a musical instrument. (2) To find out, in a group of performers on such an instrument, the relation between sight-reading ability and technical skill after various periods of study.

The author admits that traits other than sight-reading and technical skill—such traits as involve interpretation, for example— are a vital part of successful performance, but he does not regard such matters as susceptible of objective study. The test is, therefore, limited to what is termed "sight performance and practiced performance on a musical instrument."

To provide a basis for the tests, the cornet was chosen as the instrument to be used for the rather

questionable reason that fine discriminations of pitch were regarded as not of such prime importance as they would be in the case of such instruments as the violin. Such subordination of pitch requirements seems regrettable.

The construction of the performance test for the cornet was handled very carefully and purposefully. Recent methods for the instrument, published in America, were submitted to school music instructors and private teachers of the cornet, to ascertain which of the methods were most widely used throughout the country and how long the average student took to complete each of them.

The criteria which define difficulty come consistently to the foreground, particularly in the preliminary tests.

The musical measure was adopted as the scoring unit, *i.e.*, a measure was counted wrong if any error occurred within it. Such errors were carefully defined in the instructions to insure objectivity of scoring. Yet in deciding what constitutes an error, many musicians will question the criteria which exclude from such errors "pauses between measures no matter how long" and "tones badly out of tune"; for is not the difficulty, even of reading, enhanced by the player's search for perfection in intonation?

Testing with the preliminary forms offered determination of the difficulty levels and the selection of the final forms of the test. It is quoted in the conclusion that a Gestalt is involved in the reading of music and that an organismic interpretation is desirable when experimenting with melodies. It seems almost unbelievable that this same thought is not applied to the measurement of performance by the adjudicator. No provision is made for it whatsoever.

It is wisely remarked that most human skills seem to be distributed normally among the population, and it might be questioned whether all those who have a proper lip control and musculature for a desirable cupmouthpiece instrument take up the cornet or some other member of that family. A like assumption is made with reference to sight performance ability on the cornet being normally distributed. It was found that both sight-reading ability and technical skill develop at greater rates for the first two years than subsequently, the early progress being greater for the latter than the former, while later progress is the same for both. This would seem to indicate that considerable stress is being placed on technique by the teachers of beginning pupils. And now come some sad admissions, in that "above five years the shape of the curves is not reliably determined" and, further, "there is a wide variation in the abilities of different students after any period of study, some having progressed two or three times as fast as others."

The overview and summary offer some pertinent suggestions: (1) Standardized grading of music would be valuable. (2) Teachers spend too little time developing sight-reading ability. The author closes with the hope that the tests themselves will prove useful measures of achievement for the research worker and the cornet teacher. The bibliography quoted is a valuable addition to the little volume.

ABRAHAM PEPINSKY

PEDIATRICS

Advances in Pediatrics. Edited by ADOLPH G. DE SANCTIS. New York, N. Y.: Interscience Publishers, Inc. 1942.

IN starting this new series of books, the editors did not want directly to compete with reviews already in the field. The plan was to obtain articles on subjects which have shown recent advances, by authors who are sufficiently authoritative to write "personalized" summaries rather than mere compilations of abstracts. The aim is, for the most part, attained and should make the book a desirable addition to the library of all pediatricians and many general practitioners.

It is not possible to criticize the book in detail. The article on chemotherapy by B. W. Corey is adequate, but unfortunately was written before the author could properly evaluate sulfadiazine. Furthermore, he recommends sulfanilamid in streptococcal infections when it is clear that other less toxic drugs are equally effective. The discussion of electroencephalography by Major N. Q. Brill shows that much work must be done before electroencephalography reaches the usefulness of electrocardiography. R. E. Gross describes his successful method of operating on cases of patent ductus arteriosus. The knowledge of the important applications of vitamin K in pediatrics is brought up to date by H. G. Poucher. Tow's article on premature infants is somewhat uneven. He does not properly evaluate the recent work on the physiological handicaps of these infants—particularly the work of Gordon and Levine. It is now clear that premature infants can not handle high fat diets, and this fact explains why human milk is not the best food for these babies. Furthermore, failure of absorption of fat explains why high calorie feedings may appear to be necessary for premature infants since high calorie feedings are never necessary when diets low in fat are used. Tow also does not go into the recent work which shows that infants, particularly prematures, have poor renal function compared with that of later life. This explains the high water requirement as well as the susceptibility to acidosis. This knowledge, which was lacking formally, should form a firm basis for regulating the fluid intake. Also there is recent work on

the psychological reactions of babies to food, and as this work develops we may find that giving babies solid foods at a time when they can not mechanically manage them is a cause of some of the adverse reactions at meal time that are so common after the first year.

Hode's discussion of virus infections reveals that research on poliomyelitis and encephalitis has been particularly fruitful. The evidence that the virus is in the stools and that flies may carry the infection is revolutionizing all concepts of the epidemiology of poliomyelitis. Nelson's discussion of tuberculosis reveals really nothing new but gives an excellent summary of modern concepts.

The discussion of endocrinology is particularly disappointing. Apparently clinical endocrinology is still far, far behind the experimental work. There seems little excuse for saying that iodine therapy of toxic goiters leads to exacerbations when continued, since most authorities agree that it merely masks the state of hyperthyroidism. Other errors and improper evaluations are present in this article.

To general biologists and perhaps practitioners, Sabin's article on toxoplasmosis will be the most interesting. He was able to give an almost complete picture of a newly recognized protozoon infection. The organism invades almost all tissues and can occur in a wide variety of hosts. The exact mode of contagion and possible reservoirs of infection have yet to be worked out. The article should enable others to diagnose the cases and thus fill in the gaps in the picture.

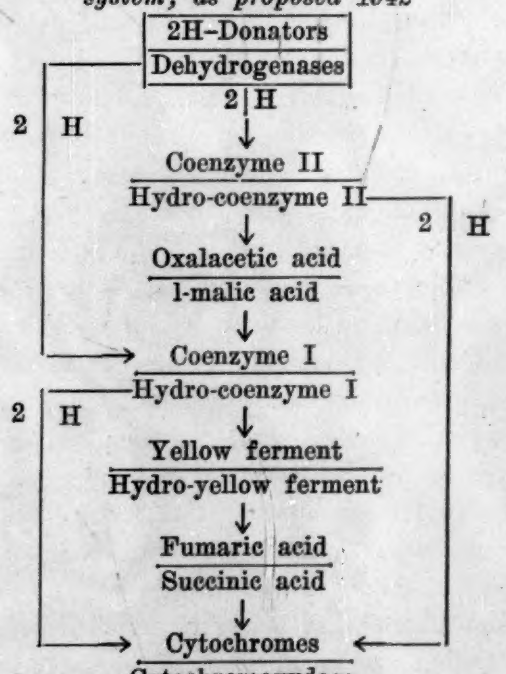
DANIEL C. DARROW
YALE UNIVERSITY SCHOOL OF MEDICINE

SPECIAL ARTICLES

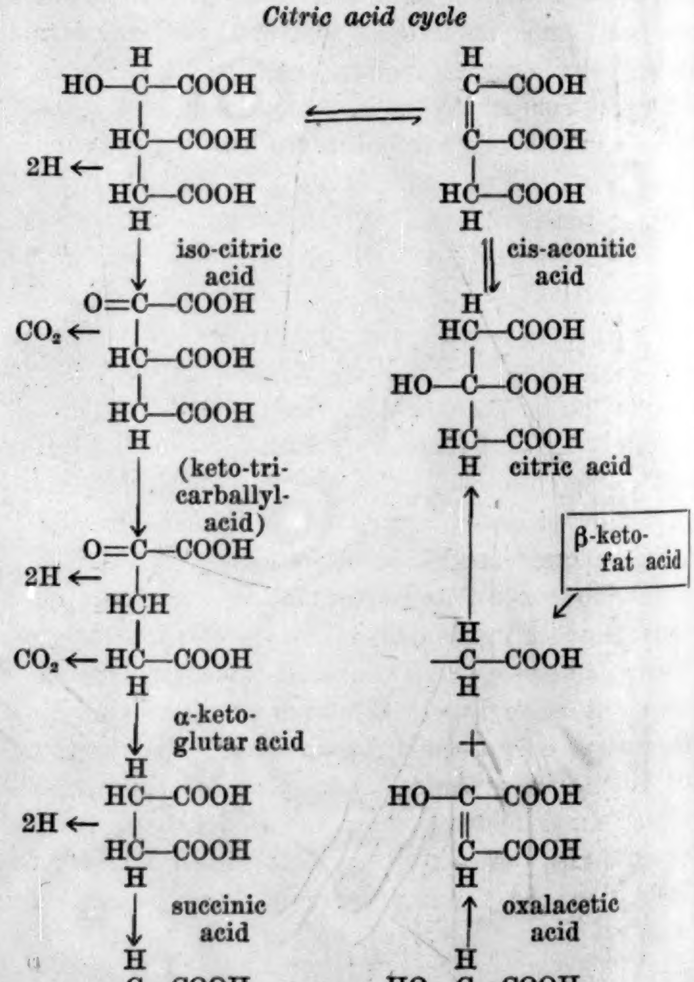
CITRIC ACID CYCLE; SUGAR AND FAT-BREAKDOWN IN TISSUE METABOLISM

KREBS and Johnston[1] suggested the citric acid cycle to be a main link in the breakdown of carbohydrates. I contended that the citric acid was artificially produced under the conditions of their experiments.[2] I have shown that all hydrogen arising from sugar breakdown is either collected with coenzym II and from there transported to oxalacetic acid (so reduced to l-malic acid), or with coenzym I and then transported to fumaric acid (so reduced to succinic acid) and to oxygen.[3] According to Krebs' first opinion all

Hydrogen-transporting system; as proposed 1942



Citric acid cycle

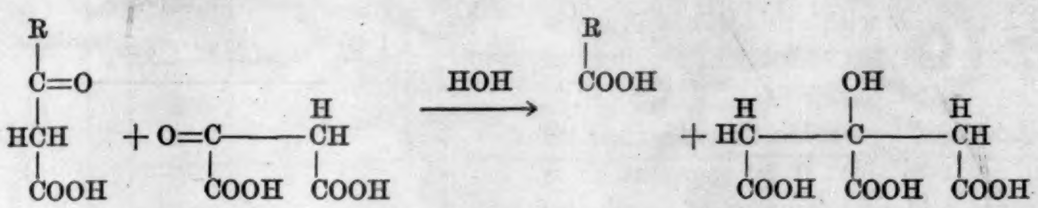


[1] H. A. Krebs and Johnston, *Enzymologia*, 4: 148, 1937.
[2] F. L. Breusch, *Zeitschr. für physiol. Chemie*, 250: 262, 1937.
[3] F. L. Breusch, *Enzymologia*, 10: 165, 1942; in print, 1943.

the carbohydrate metabolism passes over the citric acid cycle. Later on[4] he gave the cycle as accounting for only 50 per cent. of the metabolism, saying that for every cycle passed, the oxalacetic acid is reduced three times to 1-malic acid. Krebs is now[5] of the opinion that no citric acid is produced, but cis-aconitic is formed by condensation of oxalacetic acid together with a sugar breakdown product. I have been able[3] to prove that in all organs the velocity of transformation of some of the essential members of the cycle, such as citric acid and α-keto-glutaric acid to 1-malic acid, is only 3–10 per cent. of the velocity of the direct reduction of oxalacetic acid to 1-malic acid. Furthermore, the transformation of oxalacetic acid to 1-malic acid occurs in tissue also anaerobically, whilst the cycle would need large amounts of oxygen, thus definitely showing that the cycle can not play a decisive role in sugar metabolism. My views are confirmed by the work of Thomas,[6] Stare, Lipton and Goldinger,[7] Evans and Slotin[8] and Wood, Werkmann and Hemingway.[9] Perhaps the cycle takes place as a side reaction for breakdown of pyruvic acid.

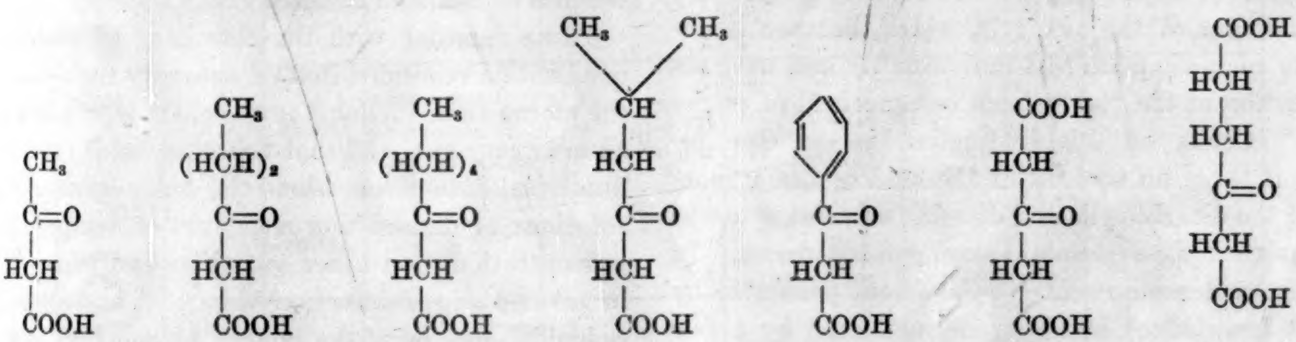
I found that the pentabromacetone reaction, hitherto employed as an analytical method in all citric acid experiments, is not specific. Acetoacetic acid, always present in tissues, gives the same reaction. This defect can be avoided by five minutes boiling of acidified analytical solutions before oxidation with Br_2 and $KMnO_4$: acetoacetic acid is destroyed; citric acid remains unchanged. Thus all previous determinations (except the method of Pucher and Sherman) on citric acid require reinvestigation.

On the contrary, the cycle is the main course in breakdown of fatty acids. Thirty-eight years ago Knoop[10] discovered β-oxidation. Though much work has been done, the subsequent course of breakdown of β-keto acids could not be detected. I have discovered a new enzyme (citrogenase), catalyzing the following reaction:



n-β-keto acid + oxalacetic acid → n-2 acid + citric acid

The n-2 acid, so produced, is again β-oxidized; the citric acid is broken down over the cycle (discovered in all main reactions by Knoop and Martius[11] and Szent-Györgyi[12]) to oxalacetic acid and two mol. carbondioxide. Citrogenase is only specific with β-keto-acids, but not specific with R. It has been shown[3] that the following β-keto-acids give the same condensation-reaction.



Not only β-keto-mono carbon acids give the breakdown condensation, but also β-keto-dicarbon acids, thus showing that also β-keto-dicarbon acids after ω-oxidation of Verkade are condensed in the same way. The enzyme occurs in large amounts in muscle, kidney, brain, but little in liver and not at all in spleen, pancreas, lung, thus confirming perfusion experiments of Snapper and Grünbaum, showing that muscle, kidney and brain metabolize large quantities of β-oxybutyric acid, liver only to a small extent and spleen and lung not at all.

The enzyme is extractable from tissue with 0.5 per cent. $NaHCO_3$; the solution is stable for some hours. It is destroyed by boiling, is sensitive to arsenic acid, to selenic acid, partly sensitive to NaF and not at all

[4] H. A. Krebs and others, *Biochem. Jour.*, 34: 442, 462, 775, 1234, 1383, 1940.

[5] H. A. Krebs, *Biochem. Jour.*, 36: IX, 1942.

[6] Thomas, *Enzymologia*, 7: 231, 1939.

[7] Stare, Lipton and Goldinger, *Jour. Biol. Chem.*, 141: 981, 1941.

[8] Evans and Slotin, *Jour. Biol. Chem.*, 136: 301, 1940; 141: 439, 1941.

[9] Wood, Werkmann, Hemingway and Nier, *Jour. Biol. Chem.*, 139: 483, 1941.

[10] Knoop, *Hoffmeister's Beiträge*, 6: 150, 1905.

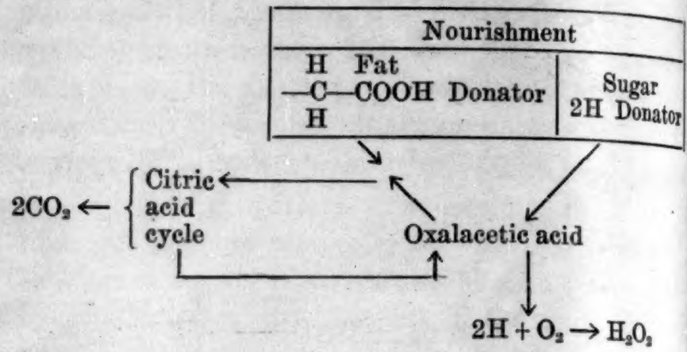
[11] Knoop and Martius, *Zeitschr. für physiol. Chemie*, 242: 1, 1935; 246: 1, 1935.

[12] Szent-Györgyi and others, *Zeitschr. für physiol. Chemie.*, 236: 1, 1935; 244: 105, 1936.

to iodacetic acid. The quantity of citric acid formed is about I–6 mg per gram wet tissue per hour at 38° C.

Oxalacetic acid is therefore the meeting point in sugar and fat metabolism. Sugar (as 2 H donator) and fat (as $-\overset{H}{\underset{H}{C}}-COOH$ donator) are in competition to metabolize oxaloacetic acid. Sugar-H is metabolized preferentially, as already small traces of sugar hydrogen reduce immediately and quantitatively small amounts of oxalacetic acid to 1-malic acid, while the condensation of β-keto acids with oxalacetic acid needs a surplus of oxalacetic acid, but only small amounts of β-keto acid.

Fat is only metabolized by oxalacetic acid, if small amounts of sugar are available; if no sugar at all is available, no pyruvic acid as precursor of oxalacetic acid (perhaps formed from pyruvic acid and carbondioxid after Evans and Slotin) is formed. Under such conditions β-keto acids are not metabolizable and we find the normal excretion of ketoacids in urine, as happens if much fat and little sugar are given with the food. We can formulate as follows:



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A MAP OF THE NATURAL AMINO ACIDS

CHART 1 has been designed as a visual aid for those whose work or interest is concerned with the protein-building α-amino acids. One may distinguish in each amino acid the $^{+}H_3N-\overset{|}{C}H-COO^{-}$ grouping which, as the carrier of the peptide-forming and acid-base functions common to all, may be termed the "body," and the remainder of the molecule, which, because it imparts to each compound its individuality and modifies the function of the "body," can be conceived of as the "head." Crude as this distinction is—as, for instance, it takes no account of the acid or basic functions of the dicarboxylic and diamino acid—it is useful as a basis for the systematic arrangement shown. In the chart each amino acid (to the extent permitted by current knowledge) has been characterized by a few data which may be considered as of fundamental chemical and biological significance. The first column of figures in the upper left corner of each space gives, in downward order, approximate figures for the optical rotation, on a molar basis, [M], in acid, neutral (isoelectric) or basic solution. The next column gives data on the dissociation constants of the acid and basic groups, expressed in pK values of acid ($-COOH$, $-OH$, $-SH$, $=NH_2^{+}$, $-NH_3^{+}$) groups. In those cases where groups other than carboxyl and amino are involved their identity is indicated by a symbol wherever possible. A figure separated by a blank space at the lower end of the pK column refers to the isoelectric point (pI). A figure in the upper right-hand corner shows the solubility at room temperature, in moles per liter. The figure to the left of the name is the molecular weight. A line under the name signifies that the amino acid is one of those found nutritionally indispensable (in rat and dog) for normal growth by Rose.[1] The dashed line (arginine) indicates that this amino acid can be synthesized by the animal organism but that the rate of bio-synthesis in the rat is not adequate for the requirements of normal growth. A dotted line under the name classifies the amino acid as one of those found necessary in the diet for the maintenance metabolism of adult rats.[2]

Those familiar with the chemistry of amino acids need not be reminded that of necessity the selection of the amino acids included in the chart is to some extent an arbitrary one, and that the same holds true for the numerical data given, where the dependence of optical rotations or dissociation constants on temperature or concentration, and other variables had to be ignored in favor of approximation values. The handbook of Schmidt[3] has been the source of most of the data shown. Blank spaces in the chart suggest possible undiscovered protein components. They do, however, neither exhaust the possibilities, nor has each space a hypothetical occupant. Spaces which for obvious reasons have no structural meaning have been marked by a black dot.

The chart is presented[4] in the hope that it may be of some use to the student, investigator and practitioner in fields ranging from physical chemistry to practical nutrition.

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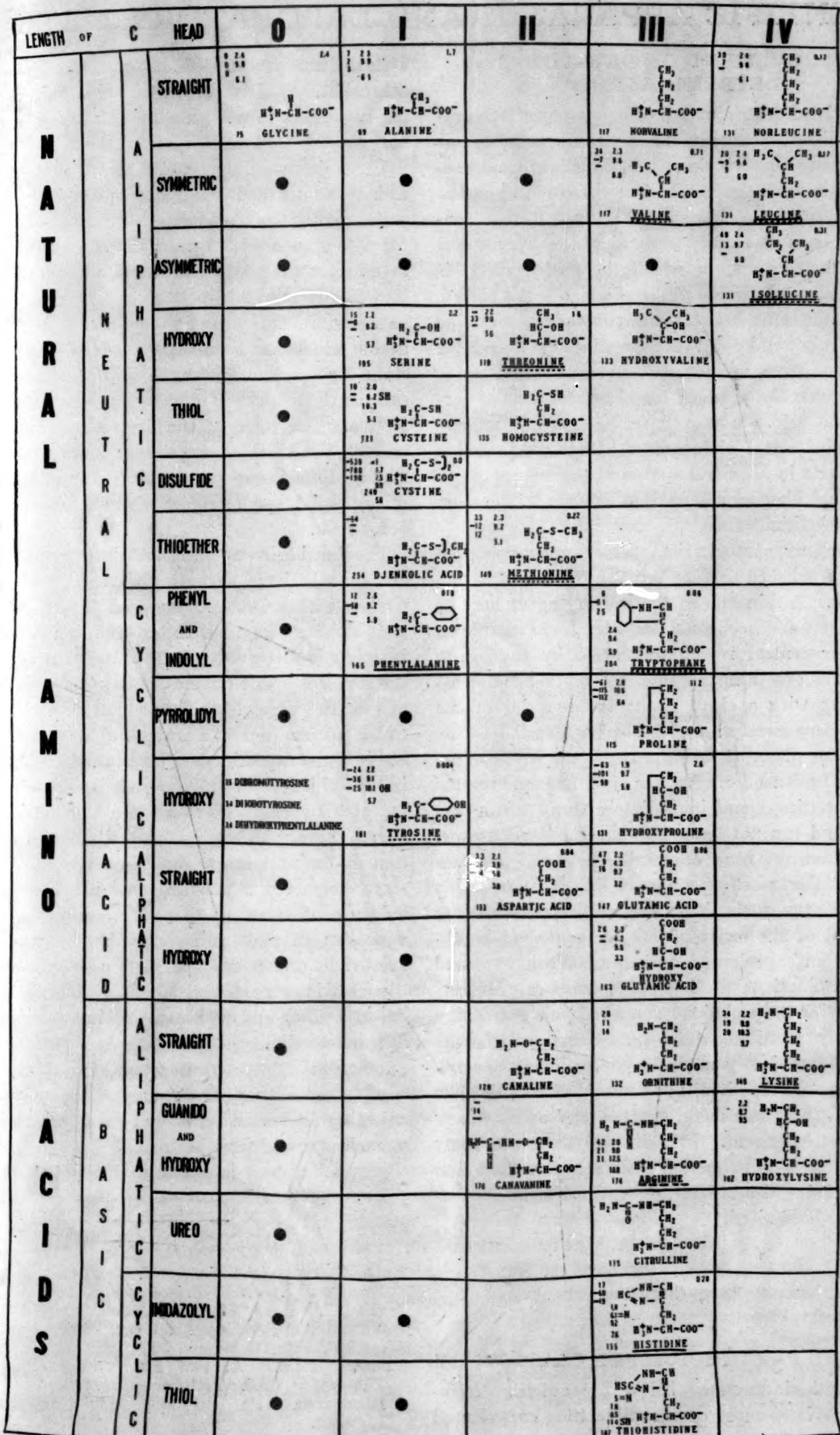
[1] SCIENCE, 86: 298, 1937.

[2] Burroughs, Burroughs and Mitchell, *Jour. Nutrition*, 19: 363, 1940.

[3] "The Chemistry of the Amino Acids and Proteins," Springfield, 1938.

[4] A limited number of reprints is available. A magnifying glass will aid in reading the small print.



LENGTH OF C HEAD
0
I
II
III
IV
NATURAL AMINO ACIDS
NEUTRAL
ALIPHATIC
CYCLIC
ACID
BASIC
STRAIGHT
SYMMETRIC
ASYMMETRIC
HYDROXY
THIOL
DISULFIDE
THIOETHER
PHENYL AND INDOLYL
PYRROLIDYL
HYDROXY
STRAIGHT
HYDROXY
STRAIGHT
GUANIDO AND HYDROXY
UREO
IMIDAZOLYL
THIOL
GLYCINE
ALANINE
NORVALINE
NORLEUCINE
VALINE
LEUCINE
ISOLEUCINE
SERINE
THREONINE
HYDROXYVALINE
CYSTEINE
HOMOCYSTEINE
CYSTINE
DJENKOLIC ACID
METHIONINE
PHENYLALANINE
TRYPTOPHANE
PROLINE
DIBROMOTYROSINE
DIIODOTYROSINE
DIHYDROXYPHENYLALANINE
TYROSINE
HYDROXYPROLINE
ASPARTIC ACID
GLUTAMIC ACID
HYDROXY GLUTAMIC ACID
CANALINE
ORNITHINE
LYSINE
CANAVANINE
ARGININE
HYDROXYLYSINE
CITRULLINE
HISTIDINE
THIOHISTIDINE

CHART 1

SCIENTIFIC APPARATUS AND LABORATORY METHODS

IMPROVEMENT OF DEW-POINT DETERMINATION

IN the visual determination of a dew-point temperature, a polished metal surface is viewed under conditions favoring sensitive detection of a slight condensation of water upon the metal. The change in apparent reflectance of the cooled surface caused by the condensation is most readily observed in a hygrometer of the Alluard type, in which the cooled metal is closely bordered by polished metal which is not cooled. However, the zone between the two surfaces can be seen, and it is well known that the minimum detectable brightness differential in a photometrical field depends critically upon the width of the zone between the portions of the field. Moreover, temperature differences in the cooled metal plate are such that condensation usually starts in a central spot, and the advantage of a closely neighboring comparison surface is therefore not of much significance.

An excellent photometrical field can be produced easily on a polished surface through the use of a wetting agent. A thin film of the wetting agent may be applied on an outer zone, leaving, for example, a rectangular central region untouched by the agent. All the film excepting an invisible layer is removed by rubbing with a clean cloth; the removal of the excess is done carefully, with strokes parallel to the edges of the plate, so that the two zones are sharply defined. Condensation of water upon the zone treated with the wetting agent immediately forms a continuous film and can not be seen, while the condensation upon the central zone occurs in the usual manner. Because of the exceedingly narrow line of demarcation between the two zones, it is believed that a reflectance differential of the order of 1.5 per cent. can be observed by an experienced operator. We have found that determinations of dew-point temperatures carried out with the technique described above are very appreciably more accurate (and more satisfying) than those previously made by the ordinary method.

From time to time it will be found desirable to clean and polish the whole metal surface, and apply a new film of wetting agent. Undoubtedly there are many agents which would function satisfactorily. The first one we tried (Victor Wetting Agent No. 35-B) left nothing to be desired.

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QUIETING PARAMECIUM FOR CLASS STUDY

THE method described below for quieting *Paramecium* obviates most of the difficulties experienced with the usual techniques of anesthesia or mechanical constraint. It has been used with uniform success for two years in our elementary zoology course, and also at Coe College.

Three grams of compressed yeast, 30 mg congo red and 10 cc distilled water are mixed thoroughly and boiled gently for ten minutes. (This amount is ample for 200 students.) A thin ring of vaseline, 15 mm in diameter, is made on a slide with a syringe, and into this is put a drop from a very rich infusion of paramecia. This drop is then stirred with a teasing needle which has been dipped one-half inch into the stained yeast, and a cover is added and pressed down sufficiently to permit observation with the 4 mm objective. The color of the drop should be pink, not red, as too thick a suspension hinders observation. The medium keeps satisfactorily for at least a week if stoppered and refrigerated, and should be shaken before use.

Feeding begins at once, and in five minutes nearly all animals have several vacuoles of diverse sizes packed with bright red yeast cells. At first the animals swim rapidly, but in less than ten minutes many individuals settle down. They tend to aggregate at the surfaces of air bubbles, clumps of yeast or masses of zooglea (which last may profitably be added), often lining up like pigs at a trough. The student can then see in different animals all stages of feeding, including the ciliary beat and currents in the gullet, the filling of the vacuole, its elongation and pinching off, its course through the cytoplasm and the eventual defecation of the apparently indigestible yeast. Moreover, since congo red is a hydrogen ion indicator, it gives evidence of chemical changes occurring in the food vacuoles: In most animals the majority of vacuoles are bright orange-red (pH 5.0 or above), but usually these are interspersed with brilliant blue vacuoles (pH 3.0 or below) and with some of intermediate purple. The indigestibility of the yeast is a possible cause of another instructive phenomenon, for it can often be seen, after a time, that some of the paramecia are rejecting all but an occasional yeast cell, and forming vacuoles packed with bacteria.

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BOOKS RECEIVED

BELL, CLIFFORD and TRACY Y. THOMAS. *Essentials of Plant and Spherical Trigonometry.* Illustrated. Pp. vi + 142. Henry Holt and Company. $1.80.

BENNETT, H. *Practical Emulsions.* Pp. x + 462. Chemical Publishing Company. $5.00.

FISHER, RONALD A. and FRANK YATES. *Statistical Tables for Biological Agricultural Medical Research.* Illustrated. Pp. viii + 98. Oliver and Boyd, Ltd. 13/6 net.